PB-216 890

REPORT ON SANITARY SURVEY OF MAURICE RIVER AND COHANSEY CREEK WITH SPECIAL REFERENCE TO POLLUTION OF OYSTERS

J. K. Hoskins

Public Health Service
Washington, D.C.

11 December 1915

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PB 216 890

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REPORT ON

SANITARY SURVEY

of

MAURICE RIVER AND COHANSEY CREEK

WITH SPECIAL REFERENCE TO

POLLUTION OF OYSTERS

by

J. K. Hoskins,

Sanitary Engineer.

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REPORT ON SANITARY SURVEY MAURICE RIVER AND COHANSEY CREEK, WITH SPECIAL REFERENCE TO POLLUTION OF OYSTERS.

Sanitary surveys of the Maurice and Cohansey Rivers, draining a portion of the southern part of the State of New Jersey, were recently made by the United States Public Health Service, with the assistance of, and in co-operation with, the New Jersey State Department of Health, to determine, if possible, the sources of pollution of these streams, resulting in the reported contamination of oysters handled in the waters near the mouths of these two rivers.

PRESENT OF OYSTER INDUSTRY:

The Oyster industry has grown to considerable size in this part of the state. Bivalve and Maurice River, two small settlements near the south of the Maurice River, are reported to handle 130 car loads of oysters daily during the busy season. Greenwich and Greenwich Pier, on the Cohansey, are also important centers of the oyster trade. The business carried on at these places amounts to several millions of dollars annually, hence serious pollution of the product, resulting necessarily in the condemnation of the oysters from these localities as an article of food, is a matter of vital concern to these towns and to the State as a whole.

METHODS OF HANDLING OYSTERS:

Oysters are grown in portions of the Delaware Bay in comparatively quiet, shallow water, the greater number of beds being in Maurice Cove, which extends from Egg Island Point to Cape May Point. The bottom of the bay here, is said to be for the most part mud, although some parts are sandy, with a depth of water ranging from 5 to 30 feet.

From these beds oysters are dredged by means of specially constructed rakes, loaded on boats, and brought to the "float areas" located in the more nearly fresh waters of the Maurice and Cohansey Rivers.

The floating process consists in placing the oysters into floats, or partially submerged open areas, located in such a way that the surface water from the river passes over and around the oysters. While in this position, the oysters open, take in a certain amount of river water, and are said to expel grit and sand; also, by this process, to rid themselves of a part of the salt brine or sea water, obtained from the beds in which they are grown. If the river water in which the oysters are floated is polluted, the floating process necessarily results in contamination of the oysters, and in many cases ultimate rejection of the oysters on the market. Oysters are usually floated for two tides, or about 24 hours, although this time may vary, due to various local conditions. Oyster floats of this nature are located on both sides of the Maurice

River at the settlements of Maurice River and Bivalve, about two miles from the mouth of the stream, and also on the Cohansey at Greenwich. When the oysters have taken in enough of the fresh river water to sufficiently reduce the salt content, they are removed from the floats to scows, brought to the wharves, counted into barrels or sacks, and shipped. During these various handlings, the oysters remain tightly closed, and the chances of contamination are comparatively slight. In order, however, to reduce this chance to a minimum, considerable care is being exercised in securing clean bags and barrels; and even the shipping cars are required to be satisfactorily cleaned before they are used for transportation.

A very small percentage of the oysters shipped from the Maurice and Cohansey Rivers are shucked; almost the entire product being shipped in the shell, so that the possibility of contamination in the shucking process is almost entirely eliminated at these points.

POLLUTED OYSTERS:

From the above brief outline, it is seen that the most probable sources of pollution of Maurice Cove Oysters, are:

1. Contamination from the waters in which they are grown.
2. Contamination by coming in contact with polluted river water during the floating process.
3. Contamination by shipping in dirty containers and cars.

The subject has accordingly been investigated from these three angles.

Without going into the details of the investigations and analyses (given in another report) it may be stated that, as a rule, oysters taken from the beds and dredges were found to be free from pollution, with good bacterial scores, and satisfactory. The water from Maurice Cove, over the beds, was also found to be of satisfactory quality. This leads to the conclusion that the oysters become polluted after they leave the beds on which they are grown.

Floated oysters, that is oysters which have been in contact with river water, have in some instances shown high scores, indicating that they have been polluted by river water in the process of floating.

Shipped oysters from the market have not been examined, but the possibilities of contamination in shipping, are believed to be almost negligible, in view of the care taken to secure clean containers and cars, and also because of the fact that the oysters remain closed during handling and shipment.

In view of the above findings, indicating that the floating process is responsible for the contamination of oysters from this region, surveys of the Maurice and Cohansey watersheds were made, to determine the sources and extent of pollution of these streams, and the conditions responsible for the pollution of oysters near the mouths of these rivers. The results of the findings in each stream will be taken up separate.

MAURICE RIVER WATERSHED

Maurice River, the largest stream in Southern New Jersey, rises near Glassboro, in Gloucester County, and flows almost due south, about 33 miles, to Delaware Bay. The entire drainage area, as shown on the accompanying map, comprising 405 square miles, is in the flat sandy formation common to Southern New Jersey, most of which is sparsely populated, and a considerable part forested. The greater part of the drainage area, lies in Cumberland County.

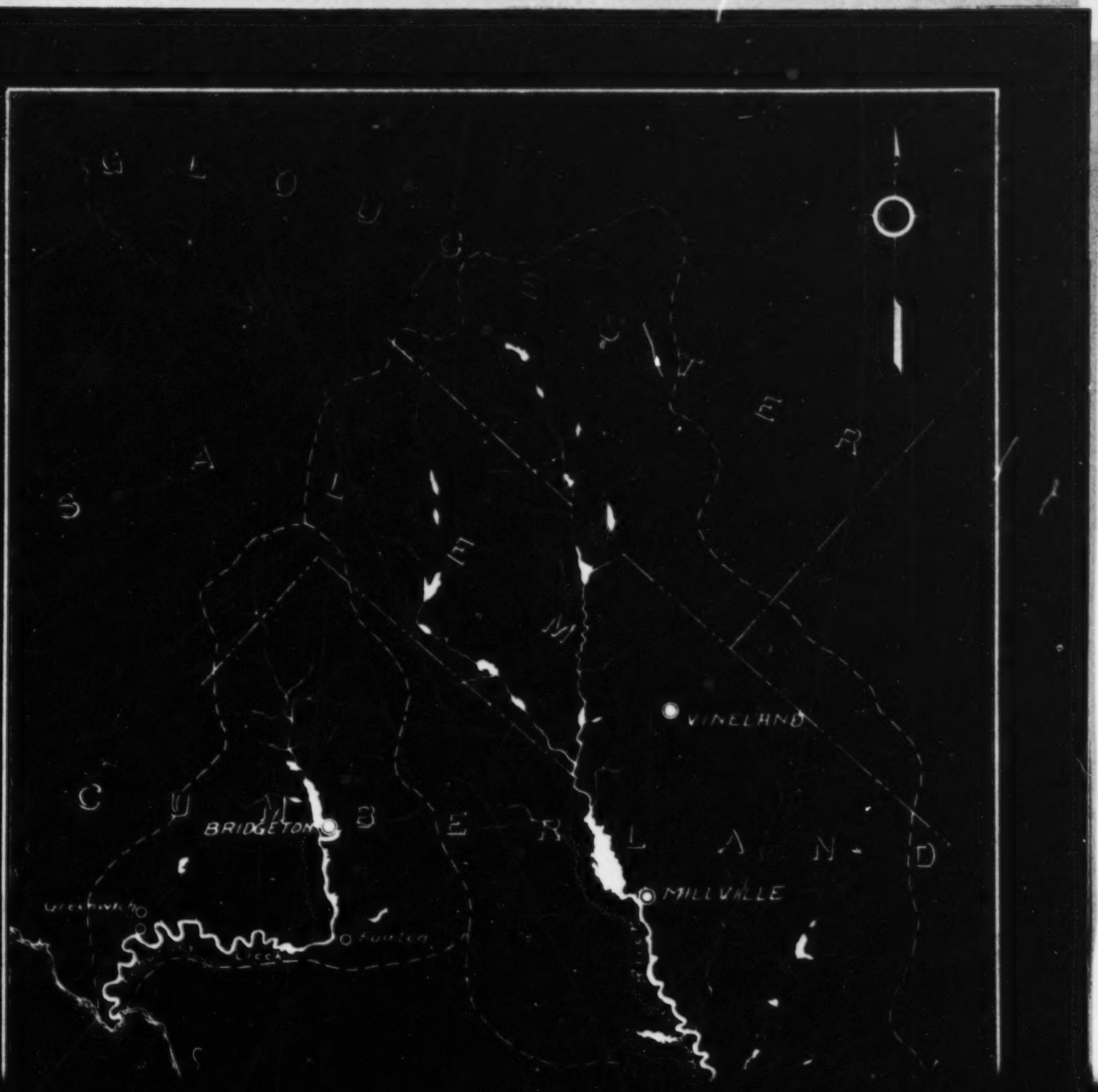
The river is navigable and tidal to a large dam at Millville, which naturally divides the stream into two parts, each of which will be considered separately.

I. RIVER ABOVE MILLVILLE:

The drainage area above the head of tide, comprises an area of 326 square miles, considerable of which is forested. The forest drainage imparts a high vegetable color to the water, the turbility usually remaining low. An earthern dam, 2200 feet long, located one-half mile above Millville, impounds the river water in a reservoir, with an area of 926 acres, forming the largest artificial lake in the State. A fall of 26 feet is made available by this dam, and the resulting power is used for industrial purposes.

Stream Flow:

Few accurate records of stream flow of the Maurice River, are available. The Report of Geo. W. T. Miller, on the


SALISBURY
VINELAND
BRIDGETOWN
MILLVILLE

VINELAND
CUMBERLAND
BRIDGETON
MILLVILLE
Greenwich
Fairton
Creek
DELAWARE BAY
MAURICE COVE
U S PUBLIC HEALTH SERVICE.
WATERSHEDS OF
MAURICE RIVER & COHANSEY CR.
Scale in miles
1915.

Maurice River, printed as Document 667 of the 29th Congress, states that the average flow at Millville is 35,300 cu. ft. per minute. Volume III of the Report of the Geological Survey of New Jersey for 1894, estimates the average flow as lower than this, or about 21,800 cu. ft. per minute. The average discharge during the driest year is estimated as 18,800 cu.ft. per minute, while the flow during the driest month is given as 3510 cu. ft. per minute.

Population:

The largest town on this part of the watershed, is Vineland, having a population in 1910 of 5282, and in 1915, estimated at 5700, while the 1915 State census gives about 6200. The rural population of the watershed is estimated at 58 per square mile, giving a total rural population of about 13,100. The total population on the watershed above Millville is therefore about 19,300, or 85.5 per square mile.

Truck farming is the principal occupation of the rural population, and a considerable portion of this area is under intensive cultivation.

Source of Pollution:

The principal and practically only direct source of pollution of Maurice River above Millville, is the city of Vineland, the domestic and industrial wastes from which are emptied into a small tributary, after being passed through a sewage disposal plant.

A sanitary survey of Vineland showed that practically all streets of the town were sewered. There are 1542 connections to the city sewers, serving 88.5 per cent of the population, or about 5,500 people. The remainder of the population, in 200 homes, use privies with watertight receptacles, which are emptied weekly, the contents being hauled to a farm outside of town and plowed under. Strict supervision by the local Board of Health, virtually precludes the possibility of stream pollution from these privies. All trades wastes are passed through the disposal plant, mixed with the domestic sewage.

The sewage disposal plant of Vineland, is located at one edge of the town, and covers an area of about six acres. The method of treatment of the sewage consists of sedimentation in a series of basins formed by embankment, filtration through underdrained sand beds, and disinfection of the filter effluent by means of hypochlorite of lime solution.

The sedimentation beds are inadequate to care for the quantity of sewage coming to them, and the sand filters are heavily overloaded. The entire plant is in urgent need of enlargement, and rearrangement. It is at present necessary to run some of the sewage to improvised settling basins, from which it is discharged direct to the creek, without sand filtration, or hypochlorite disinfection.

The final effluent is discharged into the Tarkiln branch of the Maurice River. Analyses of the effluent of the Vineland sewage disposal plant, published in the Annual Reports of the State Board of Health of New Jersey for 1909 to 1912 inclusive, show an average of 300,900 bacteria per cubic centimeter at 20°, and 26,800 bacteria at 37°, with an average count of 5,900 B. coli per cubic centimeter. The average total solids is 161 parts per million, and the average relative stability is 40. From these figures it is apparent that considerable improvement is desirable in the quality of the effluent, although the general operation of the plant is believed to be fair, under present conditions.

There are, in addition to the municipal disposal plant, two other sewage disposal plants serving institutions at Vineland. The Training School for Feeble Minded Children, disposes of all wastes by sedimentation and broad irrigation on farm land. There is no effluent discharged from this area. The Home for Feeble Minded Women has a somewhat similar process, and it is believed that little actual pollution of the water course results from this source.

The large lake above Millville and below Vineland, probably has a beneficial effect on the river water, due to the storage period afforded, with consequent sedimentation. Analyses of water taken from the outlet of this reservoir, show in many cases evidence of slight pollution, although these analyses have not been extended over a long enough period to warrant definite conclusions as to the safety of the stream at this point.

II. RIVER BELOW MILLVILLE:

The river is tidal the entire distance from Millville to its mouth. From Millville the stream flows first southeast, then southwest to Maurice River Cove, a length of 24 miles, following the windings of the river. For the first four miles below Millville, the river flows between wooded bluffs of sand, gravel, and clay, interspersed with rolling farm lands. Two miles above Mauricetown, salt marshes appear on the right bank, the upland receding more and more. On the left bank, the fast land continues to within two miles of the mouth, where salt marshes appear. Considerable areas of these low lands have been banked and are under cultivation and this work is being extended at the present time.

The channel from French's bar to Millville, has been dredged to a minimum depth of seven feet. Below French's bar the controlling depth is over 10 feet at mean low water, while in spots it reaches 40 to 50 feet.

At Millville the low water width is about 100 feet. This width is continually increasing until in the lower reaches it varies from 500 to 1000 feet.

There are four considerable tributaries to the main stream between Millville and Mauricetown. White Marsh Run and Buckshutem Creek drain the area to the west, while the Manantico and Manumuskin Creeks drain the wilderness to the east.

The drainage area of the Maurice River between Millville and the mouth, is 179 square miles, very sparsely populated, and with no sources of direct pollution except Millville. The several small settlements along the banks have no sewers and so discharge no wastes directly into the stream. Some of the land is under cultivation, and this may contribute a small amount of pollution to the main stream.

The most evident and serious pollution of the channel is caused by the City of Millville, a town having a population of 18,451 in 1910, and an estimated population of 13,437 in 1915. Millville is a rather busy industrial community employing considerable labor of a low grade. Sanitary conditions are therefore not of the best, and the enforcement of sanitary regulations has been neglected.

A sanitary survey of Millville indicated that probably 4500 of the population are connected to the sanitary sewers. Lack of records make it difficult to confirm this figure definitely. The remainder of the population depend upon cesspools and privies, many of which are in bad condition.

The sanitary sewers are poorly constructed,admitting excessive amounts of ground water, a condition which along with others, has led to the inefficient operation and practical neglect of the sewage disposal plant at the lower end of the town.

The disposal plant consists of sedimentation tanks operated in series, aeration well, contact beds, copper sulphate disinfection and tidal storage tank. The sedimentation tanks are seriously clogged and the contact beds entirely so. It is stated that copper sulphate is being added, but this has probably little effect on the bacterial content. As a result, the river is seriously polluted at this point by the discharge of poorly treated sewage from a population of at least 4500 people. Raw sewage is also discharged directly to the river from a section of the city too low to drain by gravity to the disposal plant. The industrial wastes, it is believed, are not important from a bacterial standpoint, and add little pollution of this nature.

The various settlements along the river between Millville and Bivalve, must also be considered as possible sources contributing pollution to the stream. While none of these towns sewer directly to the river, they, nevertheless, drain indirectly to the water course. Sanitary regulations are not enforced in these places, and in some cases privies are located close to the banks. In times of heavy washing rains, notably during the winter months, the danger from pollution from these villages becomes a real one. Attention must be paid to this source of pollution to insure a satisfactory quality of water in the Maurice river.

The only other apparent sources of pollution affecting the oyster floats are the towns of Bivalve and Maurice River themselves, and the oyster boats plying the river at these points. The local Boards of Health of these places have realized

the dangers of pollution from these sources, and have taken active steps to reduce them to a minimum. A complete system of scavenger service for the boats has been organized, and all excreta on the boats are deposited in cans, which are removed daily by a scavenger, and taken to farm land, all cans being cleaned and disinfected. Several privies still exist back from the shore line, but out of range of probable chances of direct polluting of the river, it is believed. Still more adequate toilet facilities for the accommodation of the laborers employed in handling oysters, will no doubt prove a benefit to local sanitary conditions near the oyster floats. Constant attention to the scavenger system will be necessary to produce effective results from this service at all times.

Tides and Currents:

The tides play an important part in the flow of Maurice River from Millville to its mouth, and it is therefore necessary to consider them in the transmission of polluting substances from Millville to the oyster floats at Bivalve. The tides of Maurice River are discussed in the report to Congress of E. A. Gieseler, Assistant Engineer U. S. Army, in reporting on improvements for that stream, and from this report information has been obtained.

High and low water both traverse the distance from the mouth of the river to Millville in about the same time - about two and one-half hours, but while the motion of high water is accelerated as it passes up stream, low water is retarded in

FAIRVIEW
Disposal Plant
CLARKS MILLS
PORT
ELIZABETH

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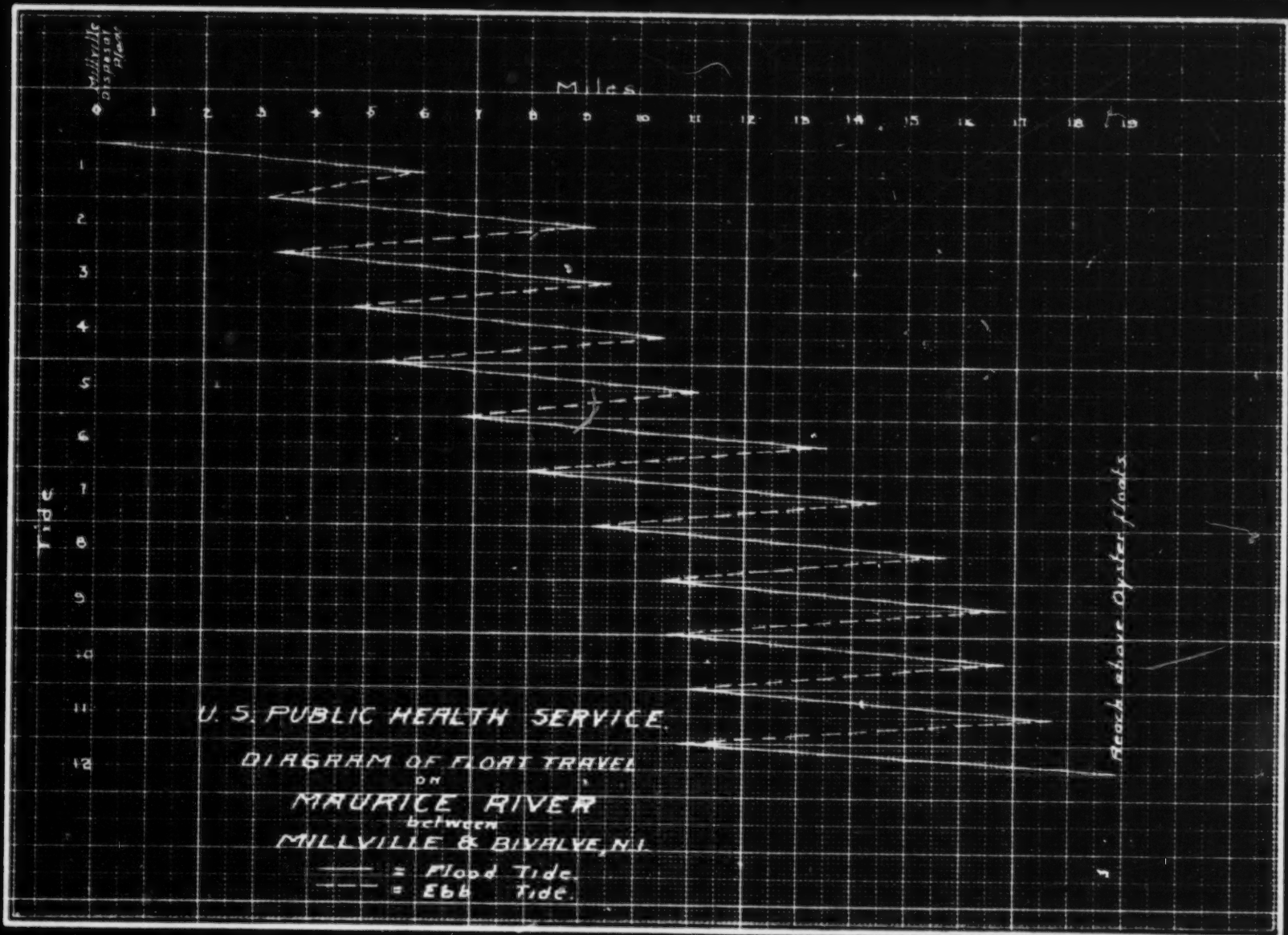
about the same proportion. The distance from the mouth to Mauricetown is traversed by high water in one and one-half hours, while from Mauricetown to Millville, only one hour is consumed. Low water on the other hand traverses the same distance in one hour and one and one-half hours, respectively. Changes of current take place at the mouth about one hour, and at Mauricetown about one-half hour, after high and low water. At Millville, the flood current changes a little before high water stand, while ebb current changes about three-fourths hours after low water stand. Thus, while at the mouth and at Mauricetown the duration of the flood current and ebb current are respectively equal to the duration of rise and duration of fall, at Millville the duration of ebb current is one hour longer than the fall, and that of flood is one hour shorter than the rise. The average rise and fall of the tide is about six feet at the mouth, and a little over five feet at Millville.

The mean tidal volume of the river has been computed at 500 million cubic feet, of which 20 million cubic feet may be fresh water received during flood tide. About the same amount being received during ebb tide, the entire discharge in six hours twenty minutes of the ebb at the mouth, amounts to about 520 million cubic feet.

The greatest mean velocity of the ebb current at the mouth is reached about 4.3 hours after high water. The discharge at this time, through a cross section of 11,430 square feet, is


Millville Disposal Plant
Miles
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19
Tide
1
2
3
4
5
6
7
8
9
10
11
12
Reach above Oyster Creek
U. S. PUBLIC HEALTH SERVICE
DIAGRAM OF FLOAT TRAVEL
ON
MAURICE RIVER
between
MILLVILLE & BIVALVE, N.J.
——— = Flood Tide.
– – – = Ebb Tide.

29,000 feet per second. The same calculation for Mauricetown gives a much smaller figure, due to the flooded meadows below Mauricetown.

In order to determine the time required for sewage to flow from Millville to the oyster floats at Bivalve, a series of float tests were undertaken and carried out jointly by the State Department of Health, and The United States Public Health Service. It is realized that these experiments give only approximate results, and not enough of them were made to determine exactly the time required, but it is believed a reasonably fair idea can be had of the currents by these experiments.

It was found that winds greatly influenced the speed and course of the floats, although they were submerged to a depth of four feet with very small area exposed. For this reason, it was decided that more nearly accurate results could be obtained by using the floats only on comparatively calm days. The floats were always allowed to run a full tide without interruption, except to keep them in the channel and prevent them from stranding. The accompanying chart shows the time required to float from the disposal plant at Millville to the reach above the oyster beds at Bivalve.

These experiments indicated that sewage from Millville may be expected to reach the oyster beds at Bivalve in six days. Under favorable conditions, this time may be shortened. It is probably safe to say that from five to ten days is consumed for Millville sewage to reach Bivalve and Maurice River.

There is probably a certain amount of sedimentation taking place during this time, due to the numerous reversals of current and also due to the mixing of the fresh and salt water, with the consequent apparent precipitation of a certain amount of color in the fresh water. The velocity of the stream, however, is such that the benefit derived from sedimentation may be comparatively small. The maximum distance traversed by the floats on one ebb tide, was seven and one-half miles in 5.8 hours, or an average rate of 2.09 feet per second. The highest rate during this time indicated a velocity of about 2.6 feet per second. It is believed that this velocity is high enough to prevent any sedimentation of consequence and probably would have a tendency to stir up considerable finer sediment deposited during slower velocities.

Taking into consideration all the factors that do contribute, or may indirectly contribute pollution to the Maurice River, it is doubtful if the waters of this stream can be considered as a safe place in which to float oysters.

The rural population on the watershed is considerable, and at all times difficult to reach by sanitary regulations. The danger from this element is greatest during the times of heavy rainfall and proportionately rapid run off, namely during the winter months. Excreta from poorly protected privies, such as are common on this watershed, at such times, are quickly carried to the nearest water course, and constitute serious pollutions. The small towns along the banks of the stream are even more important in this respect, as well as the unsewered sections of Millville.

The towns contributing sewage directly cannot be expected to discharge a safe effluent at all times, even with adequate sewage disposal plants, carefully operated. Lack of even average attention to these matters, such as is evidenced by the authorities at Millville, increases the probability of pollution from these sources. With these various contributors of pollution present, it is believed the water of the Maurice river would not be considered as a safe drinking supply, without treatment. It should therefore not be considered as a safe supply for the floating of oysters which filter considerable quantities of the polluted water through them, retaining the polluting substances and organisms, and thus magnifying the degree of pollution over that of the water in which they are placed. Further studies of the quality of the water of the river during the winter months, and during periods of high run off should be made to bear out this conclusion.

CONCLUSIONS:

From the foregoing surveys and experiments, the following conclusions have been drawn:

1. The principal important source of pollution of Maurice River, affecting the oyster beds, is imperfectly treated sewage discharged into the stream by the City of Millville.

2. The sewage from Millville may be expected to reach the oyster floats at Bivalve, 19 miles below, in from five to ten days after date of discharge at Millville. Sedimentation between

these points should not be relied upon to eliminate the danger of oyster pollution.

3. The method of sewage treatment at Millville should be revised and careful attention paid to the operation of this plant at all times.

4. The various towns along the river between Millville and Rivalve are potential, if not actual sources of pollution of the stream.

5. Unrelaxing vigilance should be exercised in enforcing sanitary regulations at Rivalve and Maurice River to prevent local pollution of the stream.

6. Even with effective sewage purification at Millville, unless active steps are taken to protect the entire watershed, it is believed the Maurice River water is an unsafe place in which to float oysters during the winter months, when high run off occurs. Further analyses of the water at such times should be made to establish conclusively this fact.

COHANSEY CREEK WATERSHED

The Cohansey Creek rises in Salem County and flows for 13 miles nearly due south to Fairton, and thence eight miles west to Delaware Bay. The drainage area, as shown on the accompanying map, comprises 109 square miles, most of which is flat sandy land, common to Southern New Jersey. The Creek is tidal and navigable to Bridgeton, nine miles in a direct line from the south, but following the thread of the stream, the distance is nineteen miles.

The drainage area above Bridgeton is about 48 square miles in extent, mostly an agricultural region, with no settlements of any size, and no towns having public sewers draining to the water course. The watershed is rather sparsely settled, and most of the pollution is drainage from cultivated farm lands and a few rural communities.

The watershed below Bridgeton, comprising an area of 61 square miles, is largely low flat ground, much of which is not cultivated, and some of which is protected from flooding at high tide in the river, by artificial banks constructed along both sides of the stream. There are no tributaries of importance below Bridgeton, and no towns having public sewers contributing direct pollution to the stream.

Analyses of the raw water of Cohansey Creek above Bridgeton, made by the State Board of Health, show the presence of B. coli rather consistently. During the year 1914, out of a total of eleven samples examined, eight indicated B. coli

present in 1 c.c., one in 0.1 c.c., and two not present in 5 c.c. From this it is evident that, notwithstanding the rather sparsely populated watershed above Bridgeton, considerable pollution reaches the stream. This pollution is considered serious enough by the City of Bridgeton, and rightly, that a modern mechanical filtration plant has been installed for the treatment of the public water supply.

The principal source of direct pollution of the upper Cohansey Creek by domestic sewage, is the City of Bridgeton, located on both sides of the stream, 19 miles from its mouth, and about 17 miles from the oyster floats at Greenwich Pier.

Bridgeton in 1910, had a population of 14,209, and an estimated population in 1915 of 14,365. The State census of 1915 gives a population of 13,840, showing a loss over the Federal census of 1910. The town is a rather busy industrial community, and the principal market centre for a rather extensive farming area in this section of the State.

A sanitary survey of Bridgeton showed that there are recorded 420 connections to the sanitary sewers. A house to house canvass made in 1909, showed that 598 houses were connected to the sewers, as stated in the report of Clyde Potts to the City of Bridgeton, under date of December 7, 1909. From this it is evident that not all connections are recorded, and it is therefore difficult to estimate the exact number of inhabitants contributing sewage. A fair estimate would perhaps be 4000 people, as using the public sewers. It is estimated

that of the remainder, 21 per cent, use cesspools, and 50 per cent, privies, and these are scattered in all parts of the town. Privies are mostly of the surface type, and some of them overhang small tributary streams. In times of heavy rains this part of the population will contribute serious pollution to the stream, due to the rather rapid drainage of the town to the Cohansey. Frozen ground in the winter months will aggravate this condition, the time when pollution of the stream is the most serious factor to the oyster industry at Greenwich.

The sewage from the public sewers is treated in two disposal plants, one located on each side of the Creek, at the down stream edge of the town.

The method of treatment consists of sedimentation in covered tanks, application of hypochlorite of lime solution to the settled sewage, and secondary sedimentation, followed by discharge into the Creek. Owing to the topography of the City, it is necessary to pump some of the sewage from the sewer mains to the sedimentation tanks. At the time of visiting this plant, these pumps were not operating, and as a result, the low level sewage flow was being by-passed around the sedimentation tanks, and discharged into the Creek without any practical disinfection. At one of the disinfection plants the hypochlorite solution tank was empty, and consequently no treatment was being secured.

Two separate visits were made to these plants, and both times the operation was found to be deficient. The conclusion formed was that the operation was careless and inefficient, and that no uniform treatment was being given the sewage

of the City, and that considerable pollution was being contributed, because of this neglect.

It was stated locally that various private sewers were discharging domestic sewage directly into the stream. No such sewers were located, although several apparently abandoned private sewers were found.

There is also considerable pollution of the Cohansey by the various industries located at Bridgeton, but few it is believed that would increase the colon content to any appreciable extent. A number of canning factories discharge large amounts of waste. A dyeing establishment discharges considerable amounts of dye waste, wash waters, and spent bleaching solutions.

The only settlement of any size between Bridgeton and Greenwich, is the village of Fairton, about four miles below Bridgeton, and having a population of about 400. Fairton has no public sewers, the entire population depending on privies, mostly of the surface type.

The nearest source of pollution of the oyster floats on the Cohansey, is at Greenwich, where these floats are located. Sanitary conditions here can be considerably improved by a more active local control. While much has been done, there still remain numbers of shacks and house boats in the vicinity which of necessity contribute pollution to the stream.

While the number of oyster boats in the Cohansey is comparatively small, the danger from pollution from this source certainly exists, and, in the vicinity of the oyster floats, may be the cause of gross pollution at times. In addition to this, the boats that use the river to Bridgeton, are under no sanitary control, and may at any time contribute wastes that will affect the oysters being floated at Greenwich.

Stream Flow:

Little data of stream flow of the Cohansey Creek is available. The New Jersey State Geological Survey Report for 1894, Vol. III, Page 257, estimates the rainfall of an average year, as 45.88 inches, of which 19.61 inches is assumed to run off, giving an average flow at Bridgeton of 46.65 million gallons per day. The same figures for an ordinary dry year are 36.80 inches rainfall, and 40.40 million gallons per day flow at Bridgeton, while for the driest period the monthly rainfall is given as 0.94 inches with 0.30 inches flowing off corresponding to a flow at Bridgeton of 8.40 million gallons per day.

The portion of the Creek from Bridgeton to the mouth, being tidal, also receives considerable amounts of sea water, which tends to dilute the sewage of Bridgeton. The entire channel acts somewhat as a tidal basin, a large body of water flowing back and forth with the rise and fall of the tide, and moving gradually toward the mouth of the stream. Potts, in his report above mentioned, estimates that this basin holds

3750 million gallons of water, and that 1500 million gallons of sea water enters the lower reaches every day. Just how much sedimentation is effected in this basin, has not been determined, but the velocity of the current, and frequent change of direction of flow, probably interfere to a considerable extent with the natural means of purification of the stream.

In order to study the currents in the stream below Bridgeton, Potts made numerous float experiments from which he determined that one ebb tide would carry a float from Bridgeton, a distance of 4¼ miles down stream, and that the following flood tide would return the float to within 800 feet of the original starting point. His deduction from these tests was that the net average gain of the water at each tide averages 1000 feet, and that during the winter months, when the run off is greatest, the gain may be as much as 2500 feet per tide. Assuming these figures as correct, the minimum time required for sewage from Bridgeton to reach Greenwich Pier, a distance of 17 miles, would be about 13½ days, remembering that the last flood tide would carry the sewage a distance of 4¼ miles. Various elements, such as height of tide, velocity and direction of wind, and excessive run off for certain periods, may tend to shorten this time by a considerable amount.

CONCLUSIONS:

In the light of the above facts, it seems fair to conclude that under present conditions, the waters of Cohansey

Creek are not safe for the floating of oysters, especially during the winter months. Bacteriological analyses of the river water at the oyster floats during periods of high run off conditions on the watershed, should be made, to confirm definitely this conclusion.

The bacterial content of the river water can be considerably lowered by a more consistent and careful operation of the sewage disposal plants at Bridgeton, but sanitary conditions of the unsewered section of the city, as well as the smaller towns on the watershed, are such that considerable pollution of the stream must be expected at all times, and especially during times of high rainfall with accompanying high run off. Strict sanitary regulations must be enforced on the entire watershed, especially on the lower portions, to effectively prevent the contamination of oysters floated in the waters of the Cohansey Creek.

45

JCW December 15, 1915.

Surgeon F. S. Cumming,
Hygienic Laboratory,
Washington, D. C.

Dear Dr. Cumming:

Replying to your letter of the 13th instant, in regard to the Maurice River report, from the data available I would consider that even with reasonably efficient treatment of Millville sewage, the river water at Bivalve would be of questionable purity. Without a considerable range of analyses of water during periods of high run off disproving this conclusion, I consider the conditions on the watershed such that the presumption is in favor of a polluted water during the winter months.

While the proper treatment of sewage at Millville, may, I do not doubt will greatly reduce the river pollution, I believe it would be unwise to maintain that treatment of the sewage would entirely remove all danger to the oyster industry, and to hold out that this is all that is required to eliminate pollution. Such a statement now, may have to be followed later by a contradiction, in case Millville acts and the results are not satisfactory, a condition entirely possible, under existing sanitary conditions in Millville, and on other parts of the watershed.

In submitting the report to you, I am assuming that you have further and sufficient bacteriological evidence of the pollution of the river, and my report is made to you from the sanitary survey side of the problem in order for you to be supported in a conclusion of the unfitness of the Maurice River for floating oysters, in case the balanced data warrants you in drawing such a conclusion. In other words, my report is intended to back you up in this question as viewed from the sanitary condition of the watershed.

Respectfully,

Sanitary Engineer.